ARITHMETICK SYMBOLICAL In one Book.

In which the Myſtery of Numeration by Symbols is revealed.

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TO THE READER.

Reader, one special use of this art of Symbols, is to expresse Arithmetical Theorems compendiously. By which means they may with far more ease, be committed to memory. But because this cannot be done by Symbols alone, without the help of other notes; I wish thee therefore to be well accquainted with these following.

Arithmeticall Notes, of excellent use in Practice, whether by common numbers, Symbols, or Figurats.

1 $=$ Equal to, Or is, between two numbers one before the other, is the note of an Equation, or of one number equall to an other, and the number before the note is the former part, and the number after it, is the latter part of the Equation: as thrice $2 = 6$, thrice 2 is equall to 6, or briefly thrice 2 is 6.

2 $+$ More by, before a number, is the ſigne of a number affirmed, or of an Addend, as $6+2$, 6 more by 2, or 2 added to 6. then $6+2=8$, 6 more by 2, is equal to 8, or ſumms 8, or is 8.

3 $-$ Leſſe by, before a number, is the ſigne of a number denied, or of a Subducend. as $8-2$, 8 leſs by 2, or 2 ſubducted from 8. then $8-2=6$, 8 leſs by 2 is equal to 6, or leaves 6; or is 6.

4 $\times$ Into, between two numbers, one before the other, is the note of a Multiplycator multiplied into a multiplicand, as 3×4, 3 multiplied into 4, or 3 into 4 or three times 4, then $3\times 4 = 12$, 3 into 4, makes 12, or is 12.

5 Several numbers ſigned with $+$, or $+$ & $-$, may ſometimes be but one factor, and the Factor is diſtinctly noted, by a comma conveniently placed, as

$6+2\times 2=10$ but $6+2,\times 2=16$

$6,-2\times 2=2$, but $6-2,\times 2=8$

$5,\times 4+2=30$, but $5\times 4,+2=22$

$5,\times 4-2=10$, but $5\times 4,-2=18$.

6 ( ) a Multiplicate note, with a Figure inſcribed, notes an equimultiplicate to the number ſignified, by the figure inſcribed, that is, it notes the fact, of a number ſo often given, and then multiplied as there are unites in the number ſignified, as (2) a Duplicate, (3) a Triplicate, 4) a Quadruplicate, (5) a Quintuplicate.

7 A Multiplicate note, after a number with

with ⋮ Trey, before the number, notes the number to be equimultiplicate, to the figure inscribed. as ⋮ 3(2) 3 Duplicate. ⋮ 3 (3) 3 Triplicate $= 3 \times 3 \times 3 = 27$ 4 ⋮ 3 (2) foure times 3 Duplicate $= 4 \times 3 \times 3 = 36$. 3 ⋮ 2 (4) 3 times [illegible]adruplicate $= 3 \times 2 \times 2 \times 2 \times 2 = 48$. 2 ⋮ 2 (2) $\times$ 3 ⋮ 2 (2) $= 6$ ⋮ 2 (5) $= 6 \times 2 \times 2 \times 2 \times 2 \times 2 = 192$. $2 \times 4 \times 3 \times 4 = 5$ ⋮ 4 (2) $= 96$.

8 —— By, between two numbers, one over the other, is the note of a Dividend. divided by a Divisor, as $\frac{12}{3}$ 12 divided by 3 or 12 by 3. then $\frac{12}{3} = 4$, 12 by 3 quotes 4, or is 4 —— By also between one number over an other, is the note of a Fraction as $\frac{2}{3}$, 2 by 3, that is, two thirds of one, or, a third of 2, or 2 of 3 parts.

9 Three numbers, being noted, with) In after the first, and (quotes after the second, are noted, to be a Divisor in a Dividend Quoting, as 3) 12 (4. 3 in 12 quotes 4, or three in 12 foure times. The Division of Fractions, is best exprest by these notes, as $\frac{2}{3}$ $\frac{3}{4}$ $\frac{9}{8}$ $\frac{2}{3}$ in $\frac{3}{4}$ quotes $\frac{9}{8}$.

10 : Decimal, before a number, is the note of a Decimal Fraction, as : 2, 2 tenths, : 0 3, 3 hundredths, 54 : 32. 54 and 32 hundreths.

11 ⋯ From, between two numbers, one before the other, is the note of the antecedent terme of a difference, from the consequent, as 3 ⋯ 7 3 from 7. 7 ⋯ 3, 7 from 3.

12 Db, Defect, before a number, is the note of a defect, as 3 ··· 7 = Db 4, 3 from 7 is defect 4.

13 Dp, Exceſſe, before a number, is the note of an exceſſe, as, 7 ··· 3 = Dp 4, 7 from 3 is exceſs 4.

14 ·· To, between two numbers, one before, or over the other, is the note of the antecedent terme of a rate, to the conſequent, as 1 ·· 3,

1   3

or ··, 1 to 3, and 3 ·· 1, or ··, 3 to 1. ſo 2 ·· 5,

3   1

2 to 5, and 5 ·· 2, 5 to 2.

15 Rb, ſubrate, before a number, is the note of a ſubrate; as 1 ··3 = R b 3, 1 to 3 is ſubrate 3.

16 Rp, Superrate, before a number, is the note of a Superrate, as, 3 ·· 1 = Rp 3 3 to 1 is ſuperate 3.

17 ⁙ Cinque, in the middeſt of foure numbers is the note of foure Arithmetical disjunct proportionals, as, 2.4 ⁙ 5.3, as 2 from 4, ſo 3 from 5, and they may alſo be noted thus, 2 ··· 4 = 3 ··· 5.

18 ⁙ after more then two numbers, is the note of Arithmetical continuall proportionals.

19 ⁙ Db, Cinque Defect, after more then two numbers, is the note of Arithmeticall continual proportionals in a defect, or in an increaſing progreſſion, as, 3.5.7.9 ⁙ Db.

20 ⁙ Dp.

20 ⁚·⁚ Dp, cinque excesse, after more then two numbers, is the note of Arithmetical proportionals in an excesse, or in a decreasing progression, as, 9.7.5.3 ⁚·⁚ Dp.

21 : : Cater in the middest of foure numbers is the note of foure Geometrical, disjunct, direct proportionals, as, 6. 2 : : 9. 3. as 6 to 2, so 9 to 3, and they may also be noted thus, 6‥2 = 9‥3.

22 ⁚⁚ Sice, in the middest of foure numbers, is the note of foure Geometrical disjunct reverse proportionals, as 9.2 ⁚⁚ 6. 3. as 9 to 2, so reversly 6 to 3.

23 : : after more then two numbers, is the note of Geometrical continuall proportionals.

24 : : Rb, cater Subrate, after more then two numbers, is the note of geometrical continual proportionals in a subrate, or in a subprogression, as, 3.6.12.24 : : Rb.

25 : : Rp, cater superate, after more then two numbers, is the note of geometrical continuall proportionals, in a superrate, or in a super progression, as, 24.12.6.3 : : Rp.

ARITHMETICK SYMBOLICALL.

CHAP. I.

A Symbol, Signes + and -- : a Name, a Multinomial.

1. BEtween the Arithmetick of common numbers, and of Figurates, Arithmetick Symbolicall is requisite to bee known, as being usefull in both, but especially in the latter.

2 Arithmetick Symbolical is the art of Numeration by Symbols.

3 A Symbol is some letter, or sometimes letters of the A, B C, representing a number either common, or Figurate, with some attribute annexed, as

Suppose the number be 5 and the Symbol A, the Symbol

Symbol represents the number not barely as it is but as it is an Addend, or a Subducend or a Factor, or a Dividend, or a Divisor, or the greater of two numbers &c.

4 Every Symbol, hath the signe + more, or — lesse either exprest, or supposed before it.

5 Every Symbol which hath not — exprest before it, is supposed to have + before it.

6 The number, or part of a number, represented by the Symbol, or Symbols after a signe, is called a Name.

7 A number consisting of many names, is called a Multinomial, as

A + E is a Binomial. A E + B — C, is a Trinomial.

Chap. II.

An Equation by Symbols. Set Symbols in general Numeration.

1 AN Equation represented by Symbols, is a general Theorem for that kinde of Numeration by numbers.

2 Therefore, Arithmetical Theorems may be set down compendiously by Symbols.

3 If the same Symbols be used in severall names of a Multinomiall, or of an equation, it will

it will be convenient to place them still in the same order, as

$AE + AE$, not $AE + EA$.

4 The set Symbols usefull in Generall Numeration, are these following; S, a Summe D, a Difference. F, a Fact. Q, a Quote.

5 A set Symbol is not so tied to the set number, but that sometimes it may represent another number, as

S, is not so tied to represent a summe but that sometimes it may represent a Factor, or some other number.

6 In Generall Numeration, the Symbols of the numbers given, being requisitly signed and noted, are equall to the set Symbol of the number required.

Chap. III.

Addition by Symbols.

ADdition connexeth the Symbols given with the signes given, as

If E be added to A, then

$A + E = S.$

$6 + 2 = 8.$

If 2 A to 3 A, then

$3A + 2A = 5A = S,$

If $-A$ to A, then
$A - A = 0 = S$
If $-2A$ to $5A$, then
$5A - 2A = 3A = S$
If $-5A$ to $2A$, then
$2A - 5A = -3A = S$
If $A - E$ to $A + E$, then
$A + E + A - E = 2A = S$
$6 + 4 + 6 - 4 = 6 + 5 = 12$
If $-A + E$ to $A + E$, then
$A + E - A + E = 2E = S$
$6 + 4 - 6 + 4 = 4 + 4 = 8$

Chap. IIII.

Subduction connexeth the Symbols given with all the signes of the Subducend changed, as

If E be subducted from A, then
$A - E = D$
$8 - 2 = 6$
If A from 3 A, then
$3A - A = 2A = D$
If 2 A from 5 A, then
$5A - 2A = 3A = D.$
If $-A$ from A, then
$A + A = 2A = D.$

If

If —2 A from 5 A, then
$4A + 2A = 7A = D$
If 5 A from 2 A, then
$2A - 5A = -3A = D.$
If A—E from A+E, then
$A+E - A+E = 2E = D$
$8+6 - 8+5 = 6+5 = 11$
If — A+E from A+E then
$A+E+A - E = 2A = D$
$8+6+8 - 6 = 8+8 = 16$

CHAP. V.

Multiplication by Symbols.

1. Multiplication connexeth the Symbolical Factors, with $\times$ into between them, as
If AB be multiplied into EG, then
$AB \times EG = F$
$21 \times 32 = 672.$

2. If a single letter, be the Symbol of Each Factor, the note $\times$ is commonly omitted, as
If A be multiplied into E, then
$AE = F$
$4 \times 3 = 12.$

If

If 2 A into 3 A, then

$$6\,AA = F.$$

$$6 \times 4 \times 4 = 96.$$

3 A Multiplicat note after a Symbol, notes the Symbol to be equimultiplicat, to the figure inscribed.

Therefore, the same Symbol may compendiously be set down often in a Fact by a multiplicat note after the Symbol, as

$$6\,AA = 6\,A(2) = F$$

$$6 \times 4 \times 4 = 6 : 4(2) = 96$$

$$A \times A(2) = A(3) = F$$

$$2 \times : 2(2) = : 2(3) = 8$$

$$A(2) \times A(3) = A(5) = F$$

$$: 2(2) \times : 2(3) = : 2(5) = 32$$

$$AE \times AE = A(2)\,E(2) = F$$

$$3 \times 2 \times 3 \times 2 = : 3(2) \times : 2(2) = 36.$$

5 If the Symbolical Factors have the same signe, the partiall Fact is affirmed: If they have contrary signes it is denied, as

$$B \times A + E = BA + BE = F$$

$$2 \times 5 + 3 = 2 \times 5 + 2 \times 3 = 16$$

$$B \times A - E = BA - BE = F$$

$$2 \times 5 - 3 = 2 \times 5 - 2 \times 3 = 4$$

$$A + E \times A + E = A(2) + 2\,AE + E(2) = F.$$

$$5 + 3 \times 5 + 3 = : 5(2) + 2 \times 5 \times 3 + : 3(2) = 64$$

$$A - E \times A - E = A(2) - 2\,AE + E(2) = F$$

$$5 - 3 \times 5 - 3 = : 5(2) - 2 \times 5 \times 3 + : 3(2) = 4$$

A +

$$A+E\times A-E=A(2)-E(2)=F$$

$$5+3\times 5-3=:5(2)-:3(2)=16$$

$$B+1\times A=BA+A=F$$

$$4+1\times 3=4\times 3+3=15$$

$$B-1\times A\times E=BAE-AE=BA-A,$$
$$\times E=BE-E,\times A=F.$$

$$5-1+3\times 2=5\times 3\times 2-3\times 2=5\times 3-3,$$
$$\times 2=5\times 2-2,\times 3=24.$$

6 Multinomiall Factors, may be written one under the other, as in common multiplication; and the partiall facts may be written like common partiall facts, only the Symbolical multiplication, proceeds most conveniently from the left hand, as

$$\begin{array}{l}
A+E\times \\
\;\;A+E \\
\hline
A(2)+AE \\
\qquad\quad +AE+E(2) \\
\hline
A(2)+2AE+E(2)\times \\
\;\;A+E \\
\hline
A(3)+2A(2)E+AE(2) \\
\qquad\quad +A(2)E+2AE(2)+E(3) \\
\hline
A(3)+3A(2)E+3AE(2)+E(3).
\end{array}$$

CHAP.

CHAP. VI.
Division by Symbols.

1. DIvision sets the Symbolical Dividend over the Divisor with — By betweene them, as

If A be divided by E, then

$$\frac{A}{E} = Q. \quad \frac{6}{2} = 3.$$

If BA by E, then

$$\frac{BA}{E} = Q. \quad \frac{3 \times 4}{2} = 6$$

$$\frac{A+E}{13} = \frac{A}{13} + \frac{E}{13}. \quad \frac{6+4}{2} = \frac{6}{2} + \frac{4}{2} = 5$$

2 How many times the same number is given more in the Dividend then in the Divisor, just so many times it is received by the quote: therefore if it be equall times given in both, it is as many times rejected, as

$$\frac{AE}{E} = A. \quad \frac{3 \times 2}{2} = 3. \quad \frac{BAE}{AE} = B. \quad \frac{3 \times 4 \times 2}{4 \times 2} = 3$$

$$\frac{AB+BE}{A+E}=B. \quad \frac{4\times5+4\times3}{5+3}=4$$

$$\frac{AB-EB}{A-E}=B. \quad \frac{5\times4-3\times4}{5-3}=4$$

$$\frac{2BA-BE.}{2A-E}=B. \quad \frac{2\times4\times5-4\times3}{2\times5-3}=4$$

$$\frac{6A(2)}{2A}=3A. \quad \frac{6:4(2)}{2\times4}=3\times4=12$$

$$\frac{A(5)}{A(3)}=A(2). \quad \frac{1:2(5)}{:2(3)}=:2(2),\text{or}\frac{32}{8}=4$$

$$\frac{BA+A}{B+1}=A+A. \quad \frac{3\times2+2}{3+1}=2+2.$$

Chap. VII.

Reductions and Numerations of Fractions by Symbols.

1. A Mixt number reduced to an improper Fraction.

$$B+\frac{E}{A}=\frac{BA+E}{A}.\quad 2+\frac{3}{5}=\frac{2\times5+3}{5}$$

$$B+\frac{CE}{A}=\frac{BA+CE}{A}.\quad 2+\frac{3\times5}{16}=\frac{2\times16+3\times5}{16}.$$

2. An improper Fraction reduced to a mixt number.

$$\frac{BA+E}{A}=B+\frac{E}{A};\quad \frac{2\times5+3}{5}=2+\frac{3}{5}$$

$$\frac{BA+CE}{A}=B+\frac{CE}{A}.\quad \frac{2\times16+3\times5}{16}=2+\frac{3\times5}{16}$$

3. A Fraction contracted, or reduced to the least termes.

If the Fraction be $\frac{A}{2A}$, then the greatest common divisor is A, and then

$A \Big)\frac{A}{2A}\Big(\frac{1}{2}$ $\quad 3\Big)\frac{3}{2\times3}\Big(\frac{1}{2}$

$3A\Big)\frac{6A}{3A(2)}\Big(\frac{2}{A}.$ $\quad 3\times5\Big)\frac{6\times5}{3:5(2)}\Big(\frac{2}{5}$

4. Different-named Fractions, reduced to cognominals, or Same-named, and withall added and Subducted.

$\frac{A}{B}+\frac{E}{G}=\frac{AG+EB}{BG}.$ $\quad \frac{7}{9}+\frac{3}{5}=\frac{7\times5+3\times9}{9\times5}$

$\frac{A}{BC}-\frac{E}{BG}=\frac{AG-EC}{BCG}.$ $\quad \frac{9}{2\times5}-\frac{4}{2\times3}=\frac{9\times3-4\times5}{2\times5\times3}$

$\frac{A}{B}+\frac{E}{G}+\frac{I}{K}=\frac{AGK+EBK+IBG}{BGK.}$

$\frac{4}{5}+\frac{6}{7}+\frac{8}{9}=\frac{4\times7\times9+7\times5\times9+8\times5\times7}{5\times7\times9}$

5. Multiplication of Fractions.

$$\frac{B}{C}\times\frac{E}{A}=\frac{BE}{CA}.\quad \frac{2}{3}\times\frac{5}{7}=\frac{2\times5}{3\times7}=\frac{10}{21}$$

$$\frac{E}{A}\times\frac{B}{E}=\frac{B}{A}.\quad \frac{E}{A}\times\frac{A}{B}=\frac{E}{B}.\quad \frac{E}{A}\times\frac{A}{E}=\frac{1}{1}=$$

$$\frac{3}{4}\times\frac{5}{3}=\frac{5}{4}.\quad \frac{3}{4}\times\frac{4}{5}=\frac{3}{5}.\quad \frac{3}{4}\times\frac{4}{3}=\frac{1}{1}=$$

$$\frac{B}{1}\times\frac{E}{A}=\frac{BE}{A}.\quad \frac{2}{1}\times\frac{3}{8}=\frac{2\times3}{8}$$

$$A\times\frac{E}{A}=E.\quad 3\times\frac{2}{3}=2.$$

$$\frac{A}{C}\times B=A\times\frac{B}{C}=\frac{AB}{C}.\quad \frac{6}{2}\times4=6\times\frac{4}{2}=\frac{6\times}{2}$$

6. Divisions of Fractions.

$$\frac{C}{B}\Big)\frac{A}{E}\Big(\frac{BE}{CA}.\quad \frac{2}{3}\Big)\frac{4}{5}\Big(\frac{3\times4}{2\times5}$$

$$\frac{E}{1}\Big)\frac{B}{A}\Big(\frac{B}{EA}\,.\quad \frac{3}{1}\Big)\frac{2}{8}\Big(\frac{2}{3\times 8}$$

$$\frac{E}{4}\Big)\frac{AB}{1}\Big(\frac{A(2)B}{E}\,.\quad \frac{2}{3}\Big)\frac{3\times 4}{1}\Big(\frac{3(2)\times 4}{2}$$

$$\frac{A}{B}\Big)\frac{A}{C}\Big(\frac{B}{C}\,.\quad \frac{A}{C}\Big)\frac{A}{B}\Big(\frac{C}{B}\,.\quad \frac{R}{A}\Big)\frac{C}{A}\Big(\frac{C}{B}\,.\quad \frac{C}{A}\Big)\frac{B}{A}\Big(\frac{B}{C}$$

$$\frac{3}{4}\Big)\frac{3}{5}\Big|\frac{4}{5}\,.\quad \frac{3}{5}\Big|\frac{3}{4}\Big|\frac{5}{4}\,.\quad \frac{4}{3}\Big|\frac{5}{3}\Big|\frac{5}{4}\,.\quad \frac{5}{3}\Big|\frac{4}{3}\Big|\frac{4}{5}$$

Chap. VIII.

Theorems directing the inference of new Equations, from an Equation given. The ground of Alligation.

1. If the same number be added to, or subducted from both parts of an Equation, the Summes and the Residues will give new Equations, as If $A+E=S$, then $A+E+B=S+B$ & $A+E-B=$
$6+4=10$ $\qquad 6+4+2=10+2.$ $\qquad (S-B$

If $A + E + B = S + B$, or $A + E - B = S - B$ then $A + E = S$.

2 Therefore, if a number, with the signe changed, be removed from one part of an Equation, to the othes, there shall be an Equation still, as

If $A + E = S$, then $A = S - E$, & $E = S - A$.
$6 + 4 = 10$.

If $A - E = D$, then $A - D = E$, & $A = E + D$
$6 - 4 = 2$.

3 If the same number multiply or divide both parts of an Equation, the facts and the quotes will give new Equations, as

If $A + E = S$, then $AB + EB = SB$,
$6 + 4 = 10$ $\quad 6 \times 2 + 4 \times 2 = 10 \times 2$

$$\& \ \frac{A}{B} + \frac{E}{B} = \frac{S}{B} . \quad \frac{6}{2} + \frac{4}{2} = \frac{10}{2}$$

4 Therefore, if a Division in a name of an Equation, multiply all the names, the facts will give a new Equation, higher then the former, as

If $\frac{E}{B} + C + D = G + \frac{A}{B}$, then

$E + BC + 13D = BG + A$.

If

If $\frac{4}{2} + 3 + 5 = 6 + \frac{8}{2} = 10$, then

$$4 + 2 \times 3 + 2 \times 5 = 2 \times 6 + 8 = 20$$

If $A + B = \frac{S}{A(2)}$, then $A(3) + B\,A(6) = S$.

If $2 + 3 = \frac{20}{:2(2)} = 5$, then $:2(3) + 3:2(2) = 20$

5. &, If a Factor in a name of an Equation, divide all the names, the quotes will give a new Equation, lower then the former, as

If $B\,A(3) = S$ then $A(3) = \frac{S}{B}$

If $3:2(3) = 24$ then $:2(3) = \frac{24}{3} = 8$.

If $A(4) + BA(3) = SA(2)$, then $A(2) + BA = S$

If $:2(4) + 3:2(3) = 10:2(2)$, then $:2(2) + 3 \times 2 = 10$.

6. If $B - A \times P = A \times P - C$, what is P?

First, $BP - AP = AP - AC$,

then $AC = 2AP - BP$.

& then $\frac{AC}{2A-B} = P$.

If $S = \overline{B - 1} \times C \times D$, what is B?

$24 = \overline{B - 1} \times 3 \times 2.$

First $\overline{B - 1} \times 3 \times 2 = B \times 3 \times 2 - 3 \times$

then $24 + 3 \times 2 = B \times 3 \times 2,$

$$\& \frac{24 + 3 \times 2}{3 \times 2} = 5 = B$$

§ 7 The ground of Alligation exprest by Symbols.

$A \times \overline{B + C} = \overline{A + B} \times C + \overline{A - C} \times B =$

$= \overline{A - B} \times \ \ + \overline{A + C} \times B = F$

$6 \times \overline{3 + 2} = \overline{6 + 3} \times 2 + \overline{6 - 2} \times 3 =$

$\overline{6 - 3} \times 2, + \overline{6 + 2} \times 2 = 30.$

Chap. IX.

Arithmetical and Geometrical disjunct proportion; The first and second rule of partnership. The Double Rule.

1 IN any kind of proportion, the Symbol of the proportional required is P.

2. In Arithmetical dis-junct proportion,

If A, B & C, be given, then $B + C - A = P$

2, 4. 3. $4 + 3 - 2 = 5$

3

3. If A. B ∷ C.P. then A.C ∷ B.P &
   2. 4 3 5
$B + C = A + P$.

4. Therefore by the second Theorem of the eighth chapter, $B + C - A = P$, & $B + C - P = A$ & $A + P - B = C$, & $A + P - C = B$.

5. In Geometrical dis-junct direct proportion, If A, B &c. be given, then $\frac{BC}{A} = P.\ \frac{2 \times 9}{6} = 3$
   2, 2, 9,

6 If A.B ∷ C.P, then A.C ∷ B.P, &
   6. 2.   9. 3.
$BC = AP$.

7. Therefore, by the fifth of the eighth chap.

$$\frac{BC}{A} = P, \& \frac{BC}{P.} = A, \& \frac{AP}{B} = C, \& \frac{AP}{C} = B.$$

8. $A.E :: AB.EB :: \frac{A}{B}.\frac{E}{B}$

$6.4 :: 6 \times 2.4 \times 2.$

9. In Geometrical dis-junct reverse proportion.

If

If A, B, & C, be given, then $\frac{AB}{C} = P$. $\frac{3\times4}{2} = 6$.
3, 4, 2,

10. If A . B : : C . P. then C . B : : A . P.
3 . 4 : : 2 . 6 2 . 4 : : 2 . 6

11. The first rule of Partnership.

If $C + D + G = A$
$10 + 6 + 4 = 20$, then

A . B : : C . P
20 . 40 : : 10 . 20
1 . 2
: : D . P
6 12
: : G . H
4 . 8

12. The Double Rule

AC . B : : EG . P
2×3 . 4 : : 5×6 . 20

13. The second Rule of Partnership:

If $CD + GH + MN = A$
$2\times3 + 4\times5 + 6\times7 = 68$
$6 + 20 + 42$. then

A . B : : CD . P
68 136 : : 2×3 . 12
: : GH . P
4×5 . 40
: : MN . P
6×7 . 84

CHAP.

CHAP. X.

Arithmetical Progression.

1. SYmbols common to Arithmetical, and Geometrical progression, are A, the first terme, B, the second, Z the last. M the name of the last terme but one, N the name of the last terme; S the summe of the progression.

2. Symbols peculiar to Arihmeticall progression, are, D a Difference, Db a Defect, Dp an Excesse.

3. In Arithmetical continual proportion, If A and B be given, then $B + B - A = P$.

$$\begin{array}{llc} 2, & 4 & 4 + 4 - 2 = 6 \end{array}$$

4. A. B. 2B—A. 3B—2A. 4B—3A & so on ∴

$$3.5.2 \times 5 - 3.3 \times 5 - 2 \times 3.4 \times 5 - 3 \times 3$$

$$3.5. \quad 7 \quad 9. \quad 11$$

$$11.9.2 \times 9 - 11.3 \times 9 - 2 \times 11.4 \times 9 - 3 \times 11$$

$$11.9. \quad 7. \quad 5 \quad 3$$

5. If A, B, C, and so on ∴, then A with Db, or Dp, or with B, being given, they give the termes following, for

6. $A + Db = B.\ B + Db - C$, and so on,

$$3 + 2 = 5.\ 5 + 2 = 7.$$

7. $A - Dp = B.\ B - Dp = C.$ and so on

$11 - 2 = 9.\ 9 - 2 = 7.$

(and so on

8. $B + B - A = C.\ B + C - A = D.\ B + D - A = E,$

$5 + 5 - 3 = 7.\ 5 + 7 - 3 = 9.\ 5 + 9 - 3 = 11.$

$9 + 9 - 11 = 7.\ 9 + 7 - 11 = 5.\ 9 + 5 - 11 = 3.$

9. $A \cdots Z = D \times M.$

10. Therefore, Db, or Dp, M & A, being given they give Z, for

$A + Db \times M = Z.$ & $A - Dp \times M = Z$

$3, + 2 \times 4 = 11$. & $11, - 2 \times 4 = 3,$

11. A, Z, & N, being given, they give S. for

$$A + Z \times \frac{N}{2} = \frac{A + 2}{2} \times N = S.$$

$$3 + 11 \times \frac{5}{2} \text{ or } \frac{3 + 11}{2} \times 5 = 36.$$

CHAP.

CHAP. XI.

Geometrical Progression.

1. SYmbols peculiar to Geometrical progression, are G the Antecedent of a Rate, H the consequent, D the Difference of the two terms; R a Rate Rb a Subrate, Rp a Superrate. RM the Rate equimultiplied to the name of the last terme but one. RN the rate equimultiplied to the name of the last terme.

2. In Geometrical continuall proportion.

If A & B be given, then $\frac{BB}{A} = P. \frac{6 \times 6}{3} = 12$

3 6

3. $A, B. \frac{B(2)}{A}. \frac{B(3)}{A(2)}. \frac{B(4)}{A(3)}$ and so on: :

$3.6. \frac{:6(2)}{3}. \frac{:6(3)}{:3(2)}. \frac{:6(4)}{:3(3)}$; :

$= 3.6.\ 12\ \ 24\ \ 48$

$$48.\ 24.\ \frac{:24(2)}{48}.\ \frac{:24(3)}{:48(2)}\ \frac{:25(4)}{:48(3)} : :$$

$$48.\ 24.\ \ 12.\ \ 6.\ \ 3.$$

4. If A, B, C, and so on : : then A with G & H, or with Rb, or Rp, or with B, being given, they give the termes following, for

5. $\frac{HA}{G} = B.\ \frac{HB}{G} = C.\ \frac{HG}{G} = D$ and so on.

If $G = 2.\ A = 5.\ A = 8.$ then $\frac{5 \times 8}{2} = 2$

$\frac{5 \times 20}{2} = 50.\ \frac{5 \times 50}{2} = 125.$

6. RbA $=$ B. RbB $=$ C. RbC $=$ D, and so on

If $Rb = \frac{5}{2} = 2{:}5,\ A = 8$, then $\frac{5}{2} \times \frac{8}{1} = \frac{40}{2}$

$\frac{5}{2} \times \frac{40}{2} = \frac{200}{4}.\ \frac{5}{2} \times \frac{200}{4} = \frac{1000}{8} = 125$

or

$$\text{Or } \frac{5}{2}\times\frac{8}{1}=\frac{40}{2}=20.\ \frac{5}{2}\times\frac{20}{1}=\frac{100}{2}=50$$

$$\frac{5}{2}\times\frac{50}{1}=\frac{250}{2}=125.$$

Or $2{:}5\times 8=20.\ 2{:}5\times 20=50.\ 2{:}5\times 50=125$

7. $\frac{B}{Rp}=B.\ \frac{B}{Rp}=C.\ \frac{C}{Rp}=D$, and so on.

If $Rp=\frac{5}{2}=2{:}5.\ A=125$, then

$$\frac{5}{2}\Big)\frac{125}{1}\Big(\frac{250}{5}.\ \frac{5}{2}\Big)\frac{250}{5}\Big(\frac{500}{25}.\ \frac{5}{2}\Big)\frac{500}{25}\Big(\frac{1000}{125}$$

$$\text{Or } \frac{5}{2}\Big)\frac{125}{1}\Big(\frac{250}{5}=50\ \frac{5}{2}\Big)\frac{50}{1}\Big(\frac{100}{5}=20$$

$$\frac{5}{2}\Big)\frac{20}{1}\Big(\frac{40}{5}=8.$$

Or

or $\frac{125}{2:5} = 50.\ \frac{50}{2:5} = 20.\ \frac{20}{2:5} = 8.$

8. $\frac{BB}{A} = C.\ \frac{BC}{A} = 20.\ \frac{BD}{A} = E$ & so on.

If $A = 8.\ B = 20$, then $\frac{20 \times 20}{8} = 50.\ \frac{20 \times 50}{8} = 125$

9. $A \cdot\cdot Z = RM.$

If $A = 8.\ Z = 125.$ or $A = 125.\ Z = 8.$ and if $M = 3.\ R = \frac{5}{2} = 2:5.$ then $R(2) = \frac{25}{4} = 6:25$

$R(3) = RM = \frac{125}{8} = 15:625$, and then

$8 \cdot\cdot 125.$ or $125 \cdot\cdot 8 = \frac{125}{8} = 15:625.$

10. Therefore Rb, or Rp, M, & A being given, they give Z, for

11. $RbM \times A = Z$, & then $\frac{Z}{RbM} = A.$ & $\frac{Z}{A} = RbM$

If

If $RbM = \frac{125}{8}$. $A = 8$, then $Z = 125$, for

$$\frac{125}{8} \times \frac{8}{1} = \frac{125}{1} . \ \& \ \frac{125}{8} \Big) \frac{125}{1} \Big(\frac{8}{1} \ \& \ \frac{8}{1} \Big) \frac{125}{1} \Big(\frac{125}{8}$$

12. $\frac{A}{RpM} = Z$, and then $RpM \times Z = A$.

If $RpM = 15{:}625$ and $A = 125$, then

$\frac{125}{15{:}625} = 8$, and then $15{:}625 \times 8 = 125$.

13. A B, and Z, of a subprogression being given, they give S, for

$B,S - Z = A,S - A$, then $BS - BZ = AS - AA$; and

$BS - AS = BZ - AA$, and then $\frac{BZ - AA}{B - A} = S$.

If $A = 3$. $B = 6$. $Z = 24$, then $S = 45$, for
$6, \times 45 - 24 = 3, \times 45 - 3$; then
$6 \times 45 - 6 \times 24 = 3 \times 45 - 3 \times 3$, and
$6 \times 45 - 3 \times 45 = 6 \times 24 - 3 \times 3$, & then

C 6 $\times$

$$\frac{6 \times 24 - 3 \times 3}{6 - 3} = 45.$$

14. In a Subduple progression $Z + Z - A = S$
$24 + 24 - 3 = 45$

15. In a subprogression $RN - 1 \times G \times A = D \times S.$

16. Therefore $\frac{RN - 1 \times G \times A}{D} = S$ & $\frac{D \times S}{RN - 1 \times G} = A$

If $Rb = 2;5.\ N = 4$, then $R(4) = RN =$ $= 39:0625.$ & $RN - 1 = 38:0625.$ & if $G = 2.\ D = 3.\ A = 8$, then $RN - 1 \times G = 76:125$ & $76:125 \times 8 = 609.$ therefore $S = 203$

for, $\frac{609}{3} = 203 = S$ & $\frac{609}{76:125} = 8 = A.$

17. $\frac{S}{RbN} =$ of a given progression, is the first terme of a new progression, in the same subrate of one terme more, and the Symbol of it

it is E, and the last terme of this new progression is S given.

If in the given progression, $Rb = 2$. $N = 4$. $RBN = 16$, $S = 45$; then in the new progression $N = 5$. $E = \frac{45}{16}$, and the termes are

$$\frac{45}{16} . \frac{90}{16} . \frac{180}{16} . \frac{360}{16} . \frac{720}{16} = 45$$

$$\text{Or } \frac{45}{16} . \frac{45}{8} . \frac{45}{4} . \frac{45}{2} . \frac{45}{1}$$

Or, 2 : 8125. 5:625. 11 : 25. 22 : 5. 45.

17. $\frac{S}{RbN} = E$, and consequently $S = RbN \times E$, and because $D \times S = RbN - 1 \times G \times A$, therefore $RbN - 1 \times G \times A = D \times RbN \times E$.

If $G = 1$. $D = 1$. $RbN - 1 = 15$. $A = 3$, then

$$15 \times 1 \times 3 = 1 \times 16 \times \frac{45}{16} = 45.$$

CHAP. XII.
Anatocisme.

1. SYmbols usefull in the computation of Anatocisme, are R. t. Rt. D. Pr. Z. Pe. S.

2. R, a set rate for an equal time.

3. t, a given number of equal times, whether they be yeares, halfe yeares, quarters, Months, or dayes.

4 Rt, the Rate equimultiplied to a given number of equall times.

5. D, the gaine of 1 lb for an equal time, or, at the end of one equall time.

6. Pr, a present payment, or a loane, or the present price of an Amount payable at the end of a given number of equal times.

7. Z the amount from a present payment at the end of a given number of equal times.

8. Pe; a Pension to last a given number of equal times.

9. S, the Amount from a Pension, at the end of a given number of equal times.

10. Three Theorems represented by Symbols follow, by which the usual problems concerning Anatocism are resolved, and by which the tables for the computation of Anatocism are made.

11. The

11. The first Theorem is, $Rt \times Pr = Z$

therefore $\frac{Z}{Rt} = Pr$,

12. The second Theorem is $Rt-1 \times Pe = D \times S$.

therefore $\frac{Rt-1 \times Pe}{D} = S$, & $\frac{D \times S}{Rt-1}$ Pe.

13 The third Theorem is $D \times Rt \times Pr =$
$Rt-1 \times Pe$.

therefore $\frac{Rt-1 \times Pe}{D \times Rt} = Pr$. & $\frac{D \times Rt \times Pr}{Rt-1} = Pe$.

Tables of

14 Amounts from present payments are made by ——— $\left.\right\}$ $Rt \times 1$ lb

15. Present payments of Amounts from present payments by ——— $\left.\right\}$ $\frac{1}{Rt}$ lb

16 Amounts

16. Amounts from Pensions by $\dfrac{Rt-1}{D}$

17. Pensions of Amounts from Pensions by $\dfrac{D}{Rt-1}$

18 Present prices of Pensions by $\dfrac{Rt-1}{D \times Rt}$

19. Pensions of present prices by $\dfrac{D \times Rt}{Rt-1}$

THE END.